Coral Reef Ecology: Have We Been Putting All of Our Herbivores in One Basket?

Mark E. Hay

A condensation of, "Patterns of Fish and Urchin Grazing on Caribbean Coral Reefs: Are Previous Results Typical?" published recently in *Ecology* (Vol. 65, No. 2). Hay is with the University of North Carolina at Chapel Hill, Institute of Marine Sciences, Morehead City, NC 28557.

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whereas others have become feeding rate maximizers over evolutionary time. For a small number of deposit-feeding polychaetes, our previous results on particle selection and the present ingestion rate data are consistent with simple energy rate maximization models.

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Herbivory is one of the primary factors affecting the organization of benthic communities on coral reefs. Herbivorous fishes and urchins have both been identified as important grazers, but well-known work conducted at Tague Bay, St. Croix and Discovery Bay, Jamaica has emphasized the impact of urchins. Assuming these locations to be typical of reefs in general, authors of both scientific papers and ecology textbooks have concluded that urchins are probably the most important grazing animals on coral reefs. Although the emphasis on urchin grazing seems well founded, given the number of studies that document its importance, almost all of these studies have been conducted on reefs where the abundance and mean size of many fish species, especially those that prey on urchins, have been reduced by overfishing. In addition, these studies come from patch reefs, not fore reefs, and involve only two field sites whose combined areas are roughly half the size of a football field. Since most marine labs are located near populated areas, the majority of ecological studies has been conducted on reefs that have experienced significant fishing pressure. Because herbivory by fishes or by urchins should select for the evolution of somewhat different responses in associated benthic organisms, attempts to extrapolate results from these reefs to reefs in general may be unjustified. Additionally, interpretation of present-day patterns within an evolutionary framework may prove to be particulary problematic.

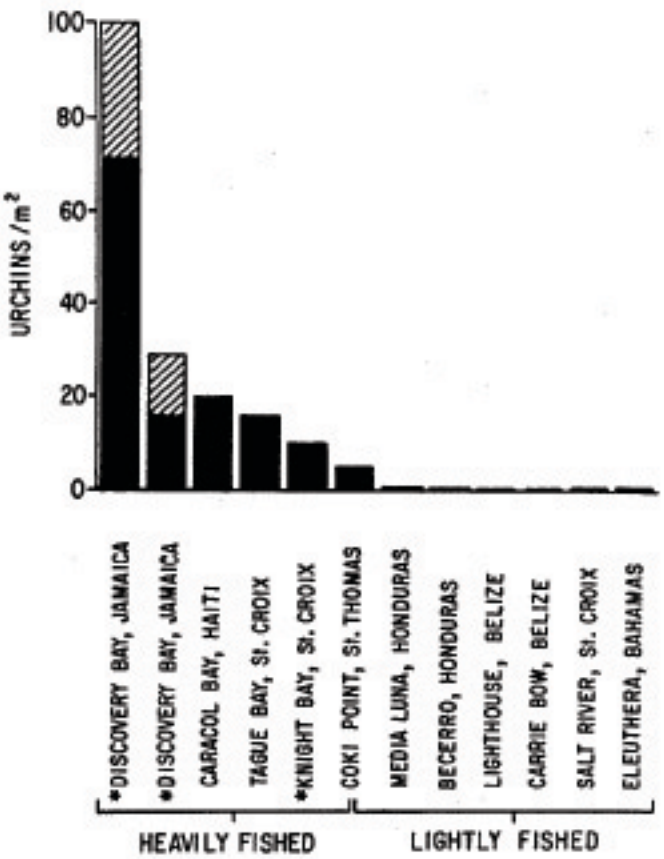

Figure 1. Mean percentage of *Thalassia* eaten per hour as a function of depth. Vertical lines are standard errors. Shaded bars show the mean percentage eaten per hour by urchins. Numbers in parentheses give the duration of each experiment. Caracol Bay and Tague Bay are heavily fished. Coki Point was fished but is now partially protected; other reefs are subject to very little fishing.

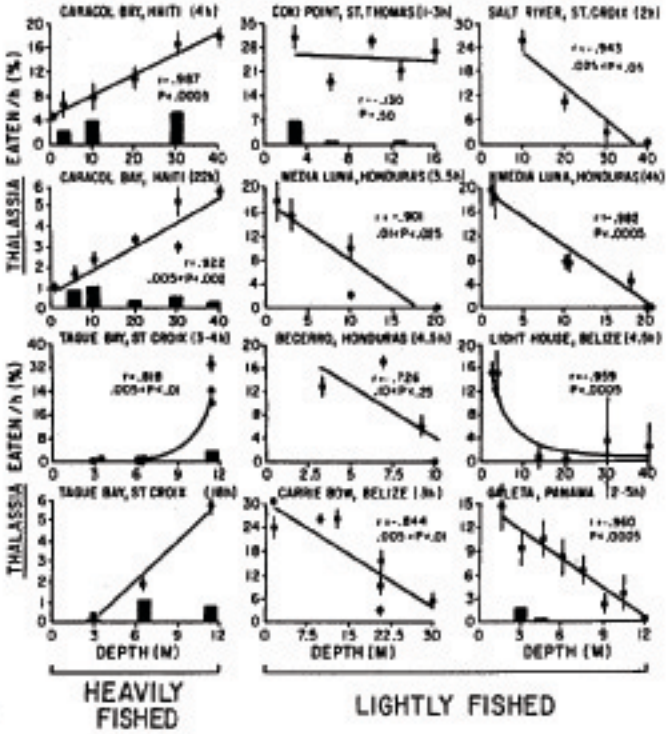

Figure 2. Urchin density on shallow (1–10 m deep) portions of fished and unfished reefs scattered throughout the Caribbean. Asterisks indicate locations where previous studies on herbivory have been conducted. When authors reported a range of densities instead of a simple mean, the histogram is crosshatched throughout that range.

To assess the possible biases inherent in working on heavily fished reefs, I transplanted sections of the seagrass *Thalassia testudinum* as a bioassay for herbivore activity. The results compare the spatial patterns of fish and urchin grazing on heavily fished and relatively unfished reefs scattered through out the Caribbean. On heavily fished reefs in Haiti and St. Croix, removal of *Thalassia* increased linearly with depth (Figure 1), urchins were abundant (Figure 2), and the amount of *Thalassia* removed by urchins at the shallow stations equaled or exceeded the amount removed by fishes (Figure 1). On lightly fished reefs, *Thalassia* removal decreased linearly with depth, urchins were rare, and fishes were responsible for almost all *Thalassia* removal (Figures 1 and 2). Field observa-

tions suggested that fishermen were removing both urchin predators and competitors on fished reefs and therefore indirectly causing an increase in urchin numbers.

That much of our information on reef ecology comes from a very few, heavily fished sites is disturbing. As shown in Figure 1, spatial patterns of herbivory determined at Haiti or St. Croix would certainly not be predictive of spatial patterns found on any of the less fished reefs. Although this study has focused on grazing by fishes and urchins, similar problems might occur concerning manatees, sea turtles, sea otters, and other organisms whose removal could have a large impact on the surrounding community. The potential importance of such missing organisms should not be overlooked when extracting evolutionary implications from ecological data or when choosing study sites. Future studies should attempt, at least on a limited scale, to replicate studies at several different sites. This would provide substantial insurance against unfortunate accidents involving baskets and eggs.